

GUHRING

The Tool Company

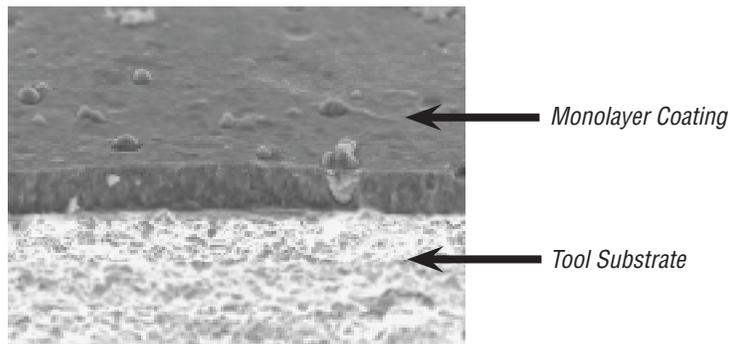
Coating and Reconditioning Services



GUHRING

Cutting tool substrates and geometries have benefited from enormous engineering advances over recent decades, and manufacturers like Guhring are continually working to make further improvements in tool productivity. Yet the heat generated during cutting tool operation, the wear caused by abrasion, and the potential for chip adhesion still remain as factors in the vast majority of workpiece materials.

Thus it is evident there is often a need for thin film coatings on cutting tools. Properly applied, coatings improve many tool and part characteristics. They increase surface hardness, lower the friction coefficient and thermal conductivity, and provide a chemically inert surface.



As a cutting tool manufacturer, Guhring offers a level of coating expertise without equal in the industry. Guhring was the first to introduce TiN coating (Titanium Nitride) to cutting tools in 1980, and has remained a global leader in developing and applying new coating technology to improve both cutting tool and wear part performance. Today, Guhring offers a full range of high performance PVD (Physical Vapor Deposition) coatings to meet customers' diverse needs.



The Guhring family of coatings includes:

- **TiN** (Titanium Nitride)
- **TiCN** (Titanium Carbonitride)
- **TiAlN** (Titanium Aluminum Nitride)
- **Super-A™** (Aluminum Titanium Nitride)
- **FIREX®** (special TiN-TiAlN multilayer hard coating)
- **MolyGlide®** (Molybdenum Disulfide-based soft coating)
- **nano-FIREX®** (special TiN-TiAlN microlayer hard coating)
- **nano-A™** (TiAlN - AlTiN microlayer hard coating)

By effectively matching the right high performance coating to each application, Guhring Coating Division maximizes tool and wear part productivity and cost effectiveness – providing great value for the investment. Performance benefits include: significantly increased tool and part life, reduced friction and heat buildup, and high resistance to edge buildup, galling and fissure propagation.

First, we clean each tool and part thoroughly in our custom-designed, five-stage ultrasonic cleaning system. Second, we sort each job by tool and part size, geometry, and material type to promote optimum coating uniformity and thickness. Properly cleaned and sorted, the tools and parts are then placed in the coating chamber. We monitor the coating process closely so that the structural integrity



In-house coating capabilities

and the geometry of the tool or part remains intact. Guhring utilizes both state-of-the-art cathodic arc and reactive ion coating systems to deliver superior coating adhesion, uniform thickness and structure, and batch-to-batch consistency.

Quality checks are integral: XRF equipment provides coating thickness measurements and material analysis, and calotests allow us to view the structure of the coating. The end result is a cutting tool or wear part with the highest quality PVD coating and a significant advantage in an application.

Where can PVD Coatings save money?

PVD applied surface coatings are successfully applied to a wide range of materials and parts. Cutting tools for the metalworking industry such as drills, taps, end mills and broaches rely on heat- and wear-resistant coatings to increase tool life and production rates, but other industries also use PVD coatings to increase productivity.

Guhring's coating service regularly coats wear parts for the mold and die industry, such as punches and stamping plates, as well as injection mold parts. Applications vary widely, from knife blades to decorative jewelry, with endless possibilities.

Try it for free!

Explore your coatings application with a free trial coating. Contact Guhring's coating service department and request a **free coating trial**. Guhring will coat a sample piece at no charge. Some limitations apply; contact Guhring for more information.



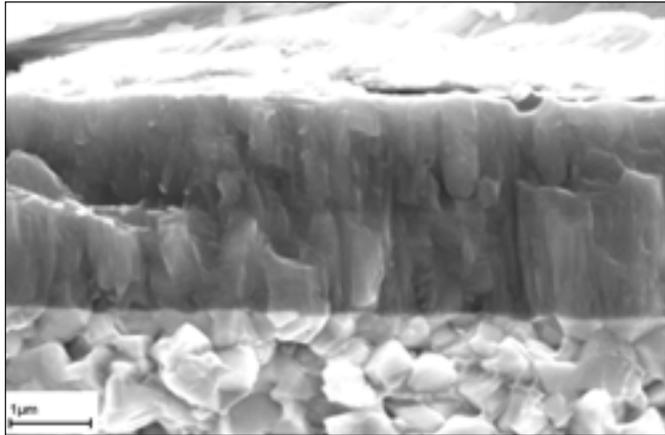
Care should be taken when packaging tools or parts to send in for coating or reconditioning services. Guhring can provide sturdy and convenient shipping totes for larger orders, or can return the tools to you in a reusable tote. Contact Guhring Coatings Division to learn more about this service.



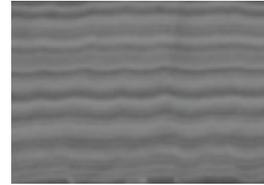
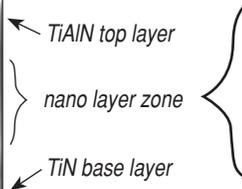
Guhring van pickup and delivery service is available in select markets. Contact Guhring's Coatings Division for more information about expedited delivery options.



nano-layer coatings



nano-FIREX® coating



Structure of nano layering - each layer is only a few nanometers thick

The newest generation of PVD coatings incorporates the heat resistance and shock resistance of a traditional multi-layer coating such as FIREX® but with a revolutionary micro layering PVD process that imparts a structure that is more uniform and cohesive. These micro-layered coatings are referred to as nano-coatings, and have some unique and beneficial properties which can improve performance and dramatically increase tool life in cutting tools and wear parts.

NEW nano-FIREX®

FIREX® coating is a PVD hard coating which combines the heat and wear resistance of TiAlN with the universal applicability of TiN coating, all in a multi-layer structure. The TiAlN in the structure increases the oxidation temperature (the point at which the coating combines with oxygen in the atmosphere and begins to break down), or operating temperature, to 1470° F. This is much higher than TiCN, which has an oxidation temperature of 840° F. Another property of TiAlN coating is that at elevated temperatures the coating will have a surface hardness of approximately 3,300 (HV 0.05), which is more than 3 times the hardness of TiCN. The multi-layering approach that combines TiAlN with TiN provides increased resistance to shock which can crack standard mono or single layer coatings.

Guhring's nano-FIREX has the same TiAlN/TiN components as standard FIREX, but in a new micro-layered structure. nano-FIREX has significantly more micro-layers in the same overall thickness than the original FIREX. This imparts superior wear characteristics, especially in applications where shock resistance is a major consideration.

NEW nano-A®

Guhring's newest PVD applied nano coating is nano-A® coating. nano-A is a multi-layer coating that combines TiAlN and AlTiN coatings in a micro-layer structure that is harder and more wear resistant. Whereas TiAlN coating has an oxidation temperature of approximately 1470° F, AlTiN coating has an oxidation temperature of approximately 1650° F, and the hardness is increased to 3,800 (HV 0.05). The micro-layer structure of nano-A makes this a better choice for applications where AlTiN would normally be used, such as hard milling steel and materials over 45 HRC; but test results have also shown that nano-A is frequently the best coating for high speed drilling and milling of all grades of stainless steels including 300 and 400 series grades.

Another unique coating from Guhring:

MolyGlide®

Initially developed for dry machining applications, MolyGlide is used in applications where increased lubricity or a very low coefficient of friction will be beneficial. MolyGlide is a MoS₂ based coating that is applied in a PVD process. This unique coating is sometimes referred to as Teflon®-like in that nothing sticks to the coating. MolyGlide can be applied on uncoated surfaces such as injection mold parts, or on top of any hard coatings such as TiN, TiAlN and FIREX, where MolyGlide can act as a barrier to material galling while the base hard coating can provide heat and wear resistance. Dry machining applications are a natural fit but many tapping and reaming applications can also benefit from MolyGlide coating, especially when machining aluminum or other "gummy" materials.



PVD coatings

Key characteristics

	Type	Identifying Color	Coating Process	Coating Temperature	Layer Structure	Thickness (µm)	Nano-hardness (HV 0.05)	Friction Coefficient (fetting)	Thermal Stability
TiN Titanium Nitride	Hard • Wear-resistant	Gold	PVD Physical Vapor Deposition	930° F 500° C	Monolayer	1.5 - 4.0	2400	0.50	1100° F 595° C
TiCN Titanium Carbonitride	Hard • Wear-resistant	Gray Violet	PVD Physical Vapor Deposition	930° F 500° C	Gradient	1.5 - 5.0	3000	0.25	840° F 450° C
TiAlN Titanium Aluminum Nitride	Hard • Wear-resistant	Black Violet	PVD Physical Vapor Deposition	930° F 500° C	Monolayer	1.5 - 4.0	3300	0.50	1470° F 800° C
FIREX® Special TiN-TiAlN	Hard • Wear-resistant	Red Violet	PVD Physical Vapor Deposition	930° F 500° C	Multilayer	1.5 - 5.0	3000-3300	0.50	1470° F 800° C
nano-FIREX® Special TiN-TiAlN	Hard • Wear-resistant	Red Violet	PVD Physical Vapor Deposition	930° F 500° C	Multilayer	1.5 - 4.0	3000-3300	0.50	1470° F 800° C
Super-A™ Aluminum Titanium Nitride	Hard • Wear-resistant	Dark Gray	PVD Physical Vapor Deposition	930° F 500° C	Monolayer	1.5 - 4.0	3800	0.60	1650° F 900° C
nano-A™ Aluminum Titanium Nitride	Hard • Wear-resistant	Dark Gray	PVD Physical Vapor Deposition	930° F 500° C	Monolayer	1.5 - 4.0	3800	0.60	1650° F 900° C
MolyGlide® MoS ₂ -Based	Soft • Lubricating	Silver	PVD Physical Vapor Deposition	305° F 150° C	Monolayer	1.0	n.a.	0.10	1470° F 800° C



Visit www.guhring.com/PS/Coating for further details

This table provides general recommendations for optimum tool and part performance with Guhring high performance TiN, TiCN, TiAlN, FIREX®, nano-FIREX® MolyGlide®, Super-A® and nano-A® coatings. Coatings can be applied to high speed steel, stainless steel, tool steel, carbide and other materials. You may also contact your local Territory Manager or Guhring's Coating Division for coating recommendations. Guhring's Coating Division coats many types of tools and wear parts, including:

- **drills** • **reamers** • **taps** • **countersinks** • **end mills** • **milling cutters** • **hobs** • **inserts** • **punches** • **dies**
- **forming tools** • **gears** • **pistons** • **die casting molds and components** • **plastic injection molds and components**

MATERIAL	APPLICATIONS					
	Drilling	Turning	Milling	Tapping	Reaming	Broaching
Steels - general types	FIREX® TiAlN TiN	TiCN TiAlN	FIREX® nano-A Super-A®	TiCN TiN	TiAlN	TiCN TiN
Alloyed Steels	FIREX® TiAlN TiN	TiCN TiAlN	FIREX® nano-A Super-A®	TiCN TiN	TiAlN	TiCN TiN
Steels Hardened <55 Rc	FIREX® TiAlN TiN	TiCN TiAlN	TiAlN	Super-A® TiAlN TiCN	TiAlN	
Steels Hardened 55-65 Rc	nano-FIREX® TiAlN	TiAlN	TiAlN	TiAlN	TiAlN	
Stainless Steels	nano-A nano-FIREX®	TiCN TiAlN	nano-A FIREX®	Super-A® TiAlN TiCN	TiAlN	
Super Alloys (Ni - Based)	nano-A nano-FIREX®	TiCN TiAlN	nano-A FIREX®	nano-FIREX®	TiAlN MolyGlide®	FIREX®
Mg - Alloys	Super-A® TiAlN	Super-A® TiAlN	Super-A® TiAlN	TiCN TiAlN MolyGlide®	TiAlN TiCN MolyGlide®	TiCN TiAlN
Cast Irons	FIREX® Super-A®	TiAlN	FIREX®	FIREX® TiAlN	TiAlN	Super-A® MolyGlide®
Ti Alloys	nano-A	Super-A® TiCN	nano-A FIREX®	TiCN MolyGlide®	TiAlN	
Al Alloys	Bright MolyGlide®	Bright MolyGlide®	Bright MolyGlide®	Bright MolyGlide®	Bright MolyGlide®	TiN MolyGlide®
Copper	TiN	Bright	TiN	TiN MolyGlide®	TiAlN	TiN
Brass / Bronze	TiCN TiN	TiCN TiN	TiCN TiN	TiCN TiN MolyGlide®	TiAlN	TiCN TiN
Plastics	TiN TiCN	TiN TiCN	TiN TiCN	TiN TiCN		

Coating Recommendations



Stamping	Deep Drawing	Forming	Injection Molding
FIREX® TiN	TiCN TiN	TiCN TiN	TiN MolyGlide®
FIREX® TiN	TiCN TiN	TiCN TiN	TiN MolyGlide®
		TiCN TiN	
		TiCN TiN	
FIREX®		TiCN	
TiCN TiN	TiCN TiN		TiN MolyGlide®
		TiCN TiN	
		TiCN	TiN MolyGlide®
TiN MolyGlide®	TiN MolyGlide®	TiN MolyGlide®	TiN MolyGlide®
TiN	TiN	TiN	TiN MolyGlide®
TiCN TiN	TiCN TiN	TiCN TiN	TiN MolyGlide®
			TiN MolyGlide®



Reconditioning Division

Turn worn cutting tools into added profits

Your investment in high-performance cutting tools is worth preserving. Extending a tool's life through quality reconditioning can greatly increase both productivity and profitability.

Guhring can restore worn standard and special carbide and PCD drills, step drills, reamers, and end mills to their original factory quality, condition and performance. We also recoat in the same facility that we recondition, allowing for quicker turn-around and excellent quality control.

Utilizing the same high-precision CNC grinding machines that are used in Guhring's manufacturing plants, our Reconditioning Division is well-equipped to restore standard and special carbide and PCD tooling to its original factory quality, condition and performance.

High precision remanufacturing delivers longer reground tool life and often more regrinds per tool, resulting in significant cost savings in terms of both tooling and machining expenses. Guhring is able to provide factory reconditioning for our own drills, step drills, end mills, and reamers – and we can provide the same high-quality service for other manufacturers' tooling as well.



- **Reconditioned to meet original factory specs**
- **High-precision CNC grinding machines**
- **Personalized customer service**
- **Reconditioning and coating same facility**

Convenient shipping totes available



and extend the life of your investment

Protect your investment

Carbide, PCD and even high speed steel tools can be damaged in transit if they are not properly packaged. Cutting edges and flutes are frequently chipped by contacting other tools and damaged beyond repair. Guhring recommends that all used cutting tools be shipped in their original plastic tubes or cases whenever possible. If the original packages are not available, hot wax dip or bubble wrap will also help protect the tools. Guhring offers a safe a convenient plastic shipping tote with foam inserts for the safest mode of transport. These durable containers can be used as a storage receptacle within a tool crib and then sent directly to Guhring's reconditioning centers when full. Fast, convenient and safe -- further reasons to choose Guhring for your tool reconditioning needs.

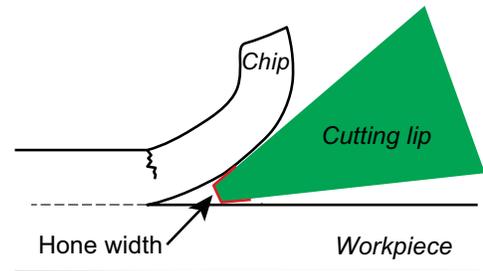
How much will it cost to recondition my tooling?

Guhring provides a fast and convenient on-line quotation option for reconditioned tools. Simply log on to www.guhring.com and click on tool reconditioning in the Products & Services tab. Here is where you can obtain a quotation for the cost of reconditioning your tools and where you can request shipping totes and specialized delivery options. You can even print out your own packing slip and a copy for your records.



Precision cutting edge hones

Significant gains have been made in the development of carbide substrates over the past decade, and newer submicron grain carbides have made carbide tools the first choice for most CNC manufacturing applications. Carbide tools are more heat and wear resistant than high speed steel alloys, and they are considerably harder, thus they can substantially increase production rates.



When reconditioning carbide drills, it is critical that that correct cutting edge hone is applied to the tooling after the drill has been re-pointed. The hone on a cutting tool is a secondary grind or brushing operation that increases the strength of the cutting edge lip. The sharp cutting edge of the tool is slightly blunted to prevent chipping which naturally occurs when extremely hard materials are made razor sharp. When properly applied, the cutting edge hone will extend tool life and increase the tool's effectiveness.

Advanced hone application technology from Guhring is applied to all our carbide tools that require cutting edge preparation, something that not all manufacturers or regrind facilities can offer. Attention to detail and superior manufacturing processes separate Guhring's reconditioning service from all others.

Drills and step drills

Who best to recondition your high performance drills than the original manufacturer? Guhring's Reconditioning Division specializes in reconditioning carbide drills, though we will regrind high volume high speed steel and cobalt drills plus step drills.

Common point angles:

90°, 118°, 120°, 130°, 135°, 140°, 150°

Standard web thinning:

- Form A** i.e. GT100 drills
- Form B** i.e. GT500 drills
- Form C** i.e. split point

Drills that are too valuable to discard after one use are drills that require high-quality regrinds. Below are examples of common drill point geometries which Guhring can regrind. Please note that we can also duplicate most manufacturers' point geometries upon request.

Guhring high performance carbide points:

- RT100 U** 2 flute, 140° angle
- RT100 X** 2 flute, 140° angle
- RT100 F** 2 flute, 140° angle
- RT100 T** 2 flute, 140° angle
- RT100 R** 2 flute, radius point
- GS200 U** 3 flute, 150° angle
- GS200 C** 3 flute, 135° angle
- RT150GG** straight flute, 120° angle
- RT150GG (cast iron)** straight flute, 130° angle

Common web thin styles:



Guhring can also duplicate most manufacturers point geometries on request. If you have any questions, please contact Guhring's reconditioning department at 800-776-6730 during business hours 7:30 am to 4:30 pm CST. You can also communicate via email to reconditioning@guhring.com.

Reconditioning Division

Carbide end mills

Guhring also offers complete reconditioning services for carbide end mills, including refurbishing of used tools and application of a corner radius. In addition to standard helix end mill designs, our reconditioning division can also recondition Guhring variable flute and variable helix carbide end mills. Please contact Guhring directly for reconditioning inquiries for non-Guhring manufactured variable flute designs.

Some common geometries:

Finishing style

Roughing style

Ball nose style

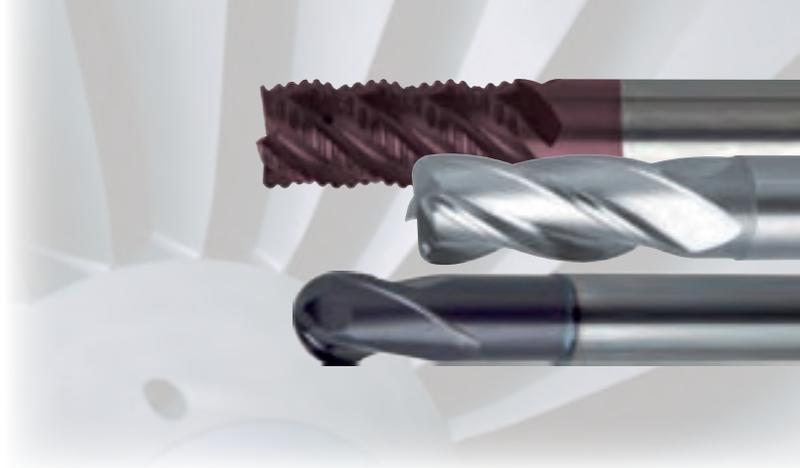
Torus nose style

Variable helix

Variable flute spacing

Corner radius grinds

Guhring recommends that all reconditioned tools be recoated with their original protective surface treatment. Guhring's in-house PVD coatings chambers can provide quick and reliable services on all reconditioned tooling.



Reamers and PCD Tooling

Fixed pocket PCD and PCBN drills, reamers, end mills and more can be reconditioned by Guhring using our state-of-the-art grinding equipment at a fraction of the price of a new tool. All reconditioned PCD tools are refurbished to the original manufacturing specifications. The original tool blueprint drawing is requested for PCD and PCBN tooling when available to assure dimensional accuracy for all tools not originally manufactured by Guhring. If the original tool is manufactured by Guhring, just provide the tool number or original manufacturing job number or even quote number to expedite the reconditioning quote process.

Extreme care should be taken when re-packaging PCD tipped tools for shipment to reduce damage during shipping. We recommend that you ship tools in their original plastic tubes or boxes when possible or separate each tool with bubble wrap to reduce the possibility of chipping the tools.



- **Tool Reconditioning and/or PVD Coatings**
- **Reliable quality**
- **Convenient service**



Trust the manufacturer known for high quality tools and for unmatched performance. As one of the worldwide leaders in metalworking cutting tools, Guhring has the unique ability to apply factory quality regrinds on nearly all types of high performance cutting tools. When quality matters, Guhring is your first choice for reconditioned cutting tools.

The same PVD coatings that Guhring applies to high performance cutting tools are available from Guhring's Coating division. Guhring can apply high quality PVD coatings to all your cutting tool and wear parts, quickly and economically. No other company has more experience than Guhring when it comes to coatings.

- **Protective and convenient plastic shipping totes available on request**
- **Quick turn-around on coating and reconditioning orders**
- **Fast online quotations available**
- **Pick-up and delivery service available***

** minimum quantities apply, contact Guhring for additional information*

Visit www.guhring.com for additional details or to request a quote

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